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## A METHOD FOR MAKING AN ALKALINE BATTERY ELECTRODE PLATE

Koshiburo Chida and Tadashi Ezaki

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(54) A METHOD FOR MAKING AN ALKALINE BATTERY ELECTRODE PLATE

(72) Inventors: Koshihuro Chida  
Sanvo Electric Co., Ltd.,  
18 Foutsu 2 chome, Kvohan,  
Moriouchi-shi

Tadashi Ezaki  
Sanvo Electric Co., Ltd.,  
18 Foutsu 2 chome, Kvohan,  
Moriouchi-shi

(71) Applicant: Sanvo Electric Co., Ltd.  
18 Foutsu 2 chome, Kvohan,  
Moriouchi-shi

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(57) Scope of Patent Claim

1. A method for making an alkaline battery electrode plate where the desired active substances are filled into a nickel foam substrate in which electrolytic oxidation reduction in an alkaline solution containing lithium hydroxide recurs.

Detailed Explanation of Invention

This invention pertains to a method for making electrode plates used in alkaline batteries. In particular, the purpose of the invention is to improve adhesion of the active substances to the electrode plate substrates and charge-discharge cycle properties of the battery by making the surface of the substrate rough with the recurrence of an oxidation-reduction reaction in an alkaline solution containing lithium hydroxide using electrode nickel foam electrode plate substrates that have been prefilled with the desired active substances (nickelic hydroxide for the cathode and cadmium hydroxide for the anode).

In comparison to the case where conventional nickel sintered plates are used, the use of nickel foam plates as the electrode plate substrate have advantages in that (1) expensive cadmium and nickel powder do not have to be used and the number of manufacturing steps are reduced and therefore, manufacturing cost is curtailed, because the sintering process is unnecessary, (2) punching metal or nickel net are not necessary as the center of the substrate and therefore, the electrode plate is lighter, (3) the battery can be miniature and light weight because volume and weight efficiency are high, and (4) the substrate has a high porosity and therefore, the impregnation process is short and manufacturing is simplified. On the other hand, there are disadvantages in that capacity deterioration that accompanies the charge-discharge process (particularly with

a large current) is high in comparison to that with sintered electrode plates.

Thereupon, it seems that capacity deterioration occurs due to peeling of the active substance from the electrode plates.

In comparison to nickel sintered plates, the nickel foam electrode plates have a high porosity and therefore, pore diameter is large. Moreover, the surface of the pore is metallic and easily slips. Consequently, adhesion between the active substance and electrode plate is poor.

This invention improves on these points. It improves adhesion between the active substances and electrode plates and the charge-discharge cycle properties of the battery by making the electrode substrate surface rough with the recurrence of an electrolytic oxidation reduction reaction in an alkaline solution containing lithium hydroxide using nickel foam substrates prefilled with the desired active substances .

This invention is explained below with an example. A nickel foam plate with a porosity of 90%, which was manufactured by conventional means, was immersed in an alkaline solution, which was obtained by adding 50 g/l of lithium hydroxide to potassium hydroxide with a concentration of 25%. After oxidation reduction occurred 10 times with a current density of  $100 \text{ mA/cm}^2$ , the plate was washed and dried to obtain an electrode plate substrate. This substrate was then filled with the desired active substance (nickelic hydroxide for the cathode active substance and cadmium hydroxide for the anode active substance) to produce an electrode plate.

The illustration is a property comparison with 6 hours of charging at 0.12 C and 2 hours of discharge at 0.25 C . One cycle was carried out with battery A, which employed the electrode plate

with the method in this invention and battery B, which employed an electrode plate manufactured with a nickel foam plate that had not been surface treated. The properties of the battery from this invention are improved.

Heretofore, various methods have been proposed for making the electrode plate surface rough in order to increase the reaction area of the electrode plate and to make the substrate surface rough in order to improve adhesion between the electrode substrates and active substances.

This invention is characterized by the fact that the surface is made rough by electrolytic oxidation reduction of the foam nickel plate in an alkali solution containing lithium hydroxide.

Although the surface of the nickel plate becomes rough when nickellic oxides and metallic nickels are produced by electrolytic oxidation reduction of the foam nickel plate in an alkali solution, with this invention lithium is contained in the nickellic oxides or metallic nickel produced by electrolysis when lithium hydroxide is added to the alkali solution. Therefore, this invention has an advantage in that the surface of the plate becomes rough, in comparison to the case when lithium hydroxide is not added. Moreover, the oxygen overvoltage of the foam nickel plate is improved because of the lithium. In addition, there is no deterioration of battery properties, even though lithium remains in the nickel foam plate when the desired substances are filled in the plate substrate. Therefore, there is improved cathodic efficiency.

As was previously mentioned, this invention pertains to a method for making an alkaline battery electrode plate whose substrate is a nickel foam plate. There is improved adherency with active substances and the cycle properties of the cell are improved because the surface becomes rough with an electrolytic

oxidation-reduction reaction in an alkali solution containing lithium hydroxide. Therefore, this invention is industrially valuable.

Brief Explanation of Invention

The diagram is a comparison of cycle properties of the battery from this invention, which employs an electrode plate whose substrate is a nickel foam plate surface treated with the method in this invention, and of a conventional battery, which employs a plate whose substrate is nickel foam that was not surface treated.

